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(54) Stretch control for web materials being joined or laminated

(57) A stretch control device for use with two web materials being laminated comprising a supply roll of a first web material. Feed rolls deliver the master material past a dancer arm and set of feed rolls with an encoder or tach generator before delivering the master material at a constant tension to a laminating roll where a second material has been delivered of greater elasticity than the master material and having a different modulus of elasticity. The second material is fed over a dancer arm for adjusting the tension on the second material, so that both materials will be equally stretched when they are joined or laminated as in a disposable diaper assembly line.

The drawing originally filed was informal and the print here reproduced is taken from a later filed formal copy.

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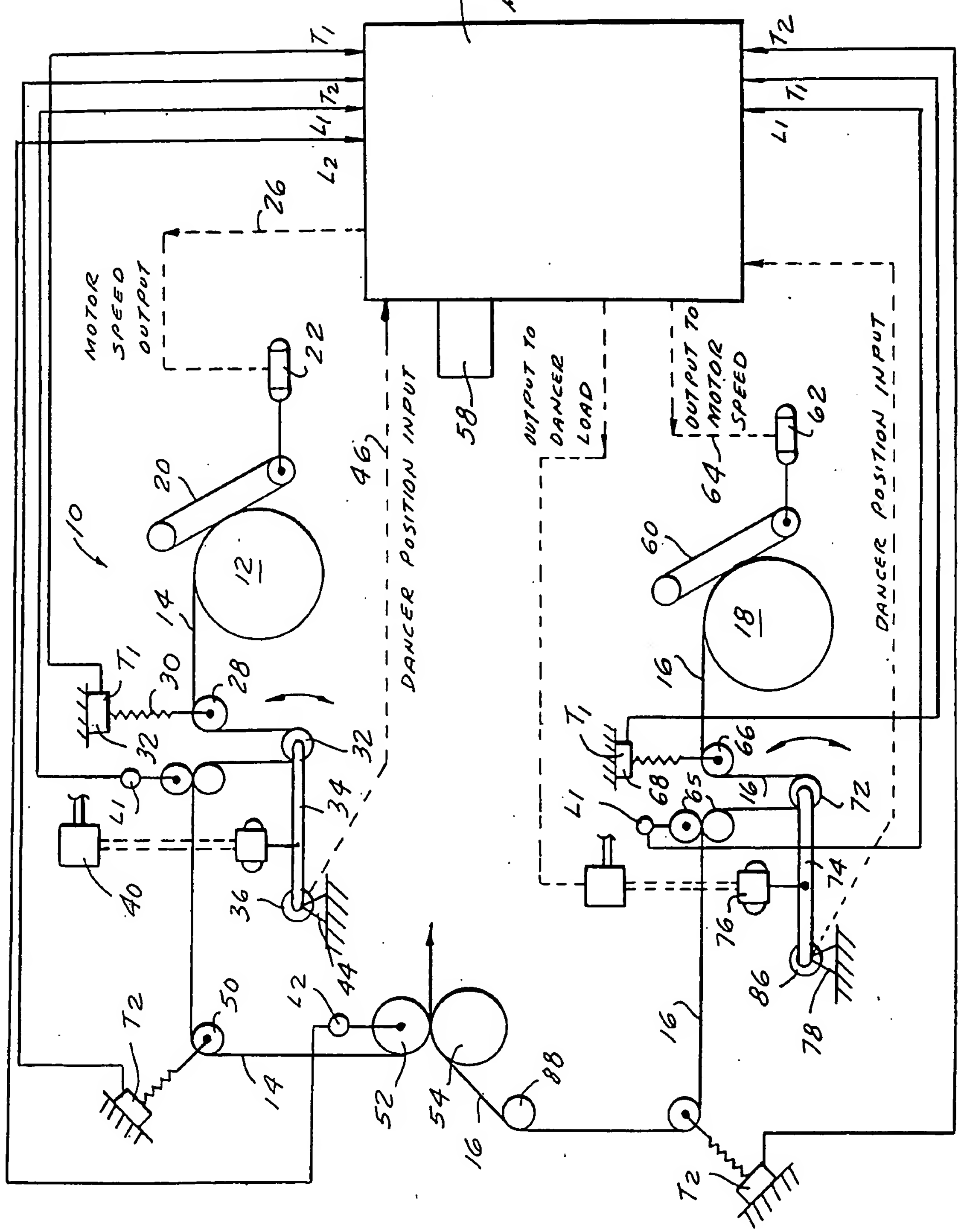
FIG. 1



SPECIFICATION

Stretch control for web materials being joined or laminated

The present invention relates to a stretch control device for use when laminating or joining two strip materials, the modulus of elasticity of one material being greater than the other.

In a disposable diaper assembly line, two webs of materials, each of which has a different modulus of elasticity, are fed to means for joining or laminating the web materials. The materials having less elasticity or otherwise designated the master material is drawn off its supply roll and fed to the laminating means and has a predetermined stretch.

The use of the material having less elasticity as the master material is a desirable compromise which permits a greater range of elasticity in the materials being used without necessitating critical adjustments in the feed of the materials being joined or laminated.

The prior art shows use of control systems to achieve constant tension on individual or all materials to be laminated and required operator skill and careful monitoring of quality of the final laminate. This is disclosed in an article entitled "The Art of Roll to Roll Adhesive Laminating", as published in *Converter* magazine, December, 1981.

Load cells and dancer arms have been used in the past to control the tension on a web being fed as disclosed in United States Patent No. 2,753,128, as well as Japanese Patent No. 44-12163 and British Patent No. 1,371,760.

United States Patent No. 2,627,296 to Secrest discloses an apparatus including means for adjusting the tension in a web of fabric.

United States Patent No. 3,239,161 to Dutro et al discloses a drive control mechanism which dispenses an elongated web of material with the speed and tension thereof being adjustable.

The United States Patent No. 3,510,374 to Walker discloses a control apparatus for sensing a property of a moving web and adjusting the moving web so that the desired property is uniform throughout the web.

United States Patent No. 3,107,679 to Pawlowski discloses an automatic tension control device which utilises either pneumatic or electrical circuitry to maintain the tension in a web of material substantially constant.

In United States Patent No. 3,762,125 to Prena, there is disclosed a device for controlling the lamination of one material onto another material which utilizes a photocoell 50, which is responsive to indicia 48 on the film "F" which sends the information to a control box 34 of a clutch 39 which controls the stretch rollers 38a and 38b to thereby keep the two webs lined up with one another.

United States Patent No. 4,347,993 to Leonard discloses a tension monitoring and controlling means which includes a controller responsive to outputs of the tension sensing transducer thereof a reference tension selector for controlling torque applied to the tension control roll to thereby control the web tension.

The present invention aims to provide a tension control device for achieving equal stretch on two materials being laminated or joined as they are pulled off their supply rolls and fed to be laminated.

According to one aspect of the present invention, a method of laminating a first or master material and a second material of greater elasticity than the master material comprises feeding the materials to laminating means and determining the stretch in each material as it is laminated and applying a variation in tension to the second material so that it arrives at the laminating means with substantially the same tension as the master material.

According to another aspect of the present invention laminating apparatus for laminating a master material and a second material, each of unknown modulus of elasticity includes laminating rolls, means for feeding each material along its own flow path to the laminating rolls, and, for each material, in its flow path, tension measuring means, and spaced linear speed measuring means located at different positions in the respective flow path, microprocessor means for receiving at least one tension signal and two linear speed signals for each material from which the modulus of elasticity of each material can be calculated, and means responsive to an output from the microprocessor for varying the tension, and hence the degree of stretch, of said second material to match its stretch to that of the master material at the laminating rolls.

The stretch control device according to the present invention may include a supply roll of a master web material. Feed rolls deliver the master material past at least one adjustable dancer arm and a tach generator before delivering the master material to laminating rolls where a second material has been delivered and whose stretch has been adjusted. The signals of the first recited tach generator and another tach generator measuring the stretch on the second material are delivered to a computer as inputs which provide outputs to another adjustable dancer arm so as to control the stretch on the master material. Friction belts are used to adjust the initial tension on both the master material and the second material as they are fed from their supply rolls.

The invention may be put into practice in various ways and one specific embodiments will be described by way of example to illustrate the invention with reference to the accompanying drawing, in which:

Figure 1 is a schematic diagram of a stretch control device according to the present invention.

In the accompanying drawing there is shown a schematic representation of a stretch control device 10 according to the present invention. The device 10 includes a supply roll 12 of a master material 14. The modulus of elasticity of the master material 14 is unknown but the master material 14 is less elastic than a second material to be delivered from its supply roll 18. The modulus of

elasticity of the material 16 is also unknown.

A friction belt assembly 20 driven by a motor 22 is provided for providing initial tension on the master material 14 as it is unwound from the feed roll 12 by a tension applied thereto in its flow path to laminating rolls 52 and 54.

The speed of the motor 22 is controlled by a microprocessor (computer) 24 by an output 26, which is based on measurements L_1, L_2, T_1 and T_2, supplied as signals to the microprocessor, as will be described, and/or a signal produced by the position of a dancer arm 34.

The master material from the roll 12 passes over a roll 28 which may be spring mounted as at 30 from a load cell 33 which produces a signal T_1. The master material 14 is fed over an idler roll 32 mounted on the adjustable dancer arm 34 which is pivotally mounted at 36. At equilibrium, the tension in the web at 30 is created by the moment of the load on the dancer arm as manually set or controlled by a pneumatic or hydraulic assembly 40 connected to or acting on the dancer arm 34. A potentiometer or rotational sensor 44 measures the position of the dancer arm 34 and provides an input 46 to the micro-processor 24 which may be used to determine a speed correction for the unwind motor 22 and/or a load on the dancer arm applied by the assembly 40. The master material 14 is then fed via a pair of feed rolls 100 over another roll 50 mounted on a second load cell 51 which produces a signal T_2 and then between laminating rolls 52 and 54 where it meets with the web material 16.

The second material 16 is of greater elasticity than the first material and the micro-processor provides for automatically controlling the feed system for the second material 16. These outputs of the micro-processor 24 are readable off the micro-processor portion 58.

An endless belt assembly 60 driven by a motor 62 controls the feed of the material 16 as it is drawn from its supply roll 18. The speed of the motor 62 is one of the outputs 64 of the micro-processor 24 and is automatically controlled by the micro-processor 24. The material 16 is entrained about a roll 66 which is connected to a load cell 68 for measuring the tension T_1 on the material 16. The tension in material 16 is created by the load necessary to lift a dancer arm 74 to a stable position. The load setting is an output of the micro-processor 24. The material 16 is entrained about an idler roll 72 mounted on the dancer arm 74, whose position is determined by the amount of material in the machine between the supply roll 18 and a first set of feed rolls 65 and the elasticity of that material for the tension level required to support the dancer arm. The control method for keeping the dancer arm stable or at mid-range is to adjust the unwind motor speed automatically to correct the dancer arm position. For a given material, tension and feed roll setting, there will be only one correct unwind speed at stability. The dancer arm is pivotally mounted as at 78 and its position may be monitored by a potentiometer or rotary sensor 86, or other means to provide an appropriate signal, via line 79 to the microprocessor 24. The dancer arm may be of any of the well-known recognized types, such as pivoted vertically or multi-pass units or linearly-transported dancer rolls.

The material 16 is then passed to the laminating rolls 52 and 54 where the material 16 will join the master material 14 with the same stretch thereon so that, when these materials are laminated or joined together, there will be little or no warping or breakage and there will be no curling at relaxation after cut-off.

From a consideration of the arrangement of parts, either feed system heretofore described can be used for the master material, the inputs to the micro-processor being set dependent on the system used for the master material. This provides for a greater range of materials since the stretch on the more elastic material can best be adjusted to equal the stretch on the master material as the resulting change in total tension in the laminate of the two webs will be reduced.

CLAIMS

1. A method of laminating a first or master material and a second material of greater elasticity than the master material which comprises feeding the materials to laminating means and determining the stretch in each material as it is laminated and applying a variation in tension to the second material so that it arrives at the laminating means with substantially the same tension as the master material.

2. A method as claimed in Claim 1 in which the master material is fed to the laminating means at a fixed tension.

3. A method as claimed in Claim 1 or Claim 2 which comprises drawing the first material off a source of supply and applying a controlled resistance to said drawing off so as to stretch the first material by a controlled variable amount, and in which the length of the first material per unit of time is measured as it passes a first location spaced from the point of lamination and its length per unit of time is measured again as it is laminated, and the tension on the first material is measured at second and third locations on either side of the first location so that in its passage to the laminating means the first material passes the second location, then the first location and then the third location, and the values of length per unit of time and tension of the first material, together with a calculated degree of stretch of the second material at the laminating means are used to compute what variation in stretch in the first material is needed to make its stretch when laminated substantially the same as that of the second material and the resistance to drawing off is varied so as to produce any necessary change in stretch of the first material.

4. A method as claimed in Claim 1 substantially as specifically described herein with reference to the accompanying drawing.

5. A stretch control device for material to be laminated comprising means for feeding a master

material at a fixed tension to laminating means, a supply roll of a second material having greater elasticity than the said master material, means for feeding the said second material to the said laminating means, means for measuring and calculating the amount of stretch in each material, and means for varying and applying a calculated tension on the said second material as it is fed to the said laminating means so that the stretch on the second material will be the same as that on the said master material.

6. A stretch control device as claimed in Claim 5, including micro-processor means for providing an output for setting the said means for varying and applying tension on the said second material.

7. A stretch control device as claimed in Claim 5 or Claim 6, in which the said means for varying and applying tension to the said second material is a movably mounted dancer arm about which the said second material is entrained.

8. A stretch control device as claimed in Claim 5, 6 or 7 in which the said means for varying and applying tension to the said second material is a movably mounted dancer arm about which the said second material is entrained, and means for varying the position of the said dancer arm.

9. A stretch control device as claimed in Claim 5, 6, 7 or 8 including micro-processor means for providing an output for setting the said means for varying and applying tension to the said second material, the said means for varying and applying tension to said second material including a movably mounted dancer arm about which the said second material is entrained, and means for varying the position of the said dancer arm according to an output from the said micro-processor means.

10. Laminating apparatus for laminating a master material and a second material, each of unknown modulus of elasticity, including laminating rolls, means for feeding each material along its own flow path to the laminating rolls, and, for each material, in its flow path, tension measuring means, and spaced linear speed measuring means located at different positions in the respective flow path, microprocessor means for receiving at least one tension signal and two linear speed signals for each material from which the modulus of elasticity of each material can be calculated, and means responsive to an output from the microprocessor for varying the tension, and hence the degree of stretch, of said second material to match its stretch to that of the master material at the laminating rolls.

11. Laminating apparatus as claimed in Claim 10, in which the said means for varying and adjusting the tension on the said second material include a movably mounted dancer arm about which the said material is entrained.

12. Laminating apparatus as claimed in Claim 10 or Claim 11 in which the said means for varying and adjusting the tension on the said second material include a movably mounted dancer arm about which the said second material is entrained, and pneumatic means for adjusting the position of the said dancer arm.

13. Laminating apparatus as claimed in Claim 10, 11 or 12 in which the said means for varying the tension on the said second material includes an endless belt engaging a feed roll for the second material, and a motor for driving the said endless belt.

14. Laminating apparatus as claimed in any one of Claims 10 to 13 in which the said means for varying and adjusting the tension on the said second material include a movably mounted dancer arm about which the said second material is entrained, and pneumatic means for adjusting the load on the said dancer arm, the said means for varying the tension on the said second material further including endless belt means engaging a feed roll of the said second material thereby applying a variable initial tension on the said second material.

15. A stretch control device as claimed in Claim 1 substantially as specifically described herein with reference to the accompanying drawing.

16. Apparatus for laminating materials incorporating a device as claimed in any one of Claims 5 to 15.

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